

**Finishing to untangling the taxonomic knot:
new species of the genus *Bulbaeolidia* Carmona, Pola,
Gosliner & Cervera, 2013 (Mollusca: Aeolidiidae)
from the Caribbean and Galapagos**

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ABSTRACT

The nudibranch gastropod genus *Aeolidiella* Bergh, 1867 has been found to be polyphyletic. It holds an unnamed clade that was named *Bulbaeolidia* Carmona, Pola, Gosliner & Cervera, 2013. This genus is composed by four species, two of them unnamed: *Bulbaeolidia alba*, from Japan, Malaysia and Philippines, *Bulbaeolidia japonica*, from Japan, *Bulbaeolidia* sp. B, from Hawaii, and *Bulbaeolidia* sp. A, from Brazil. *Bulbaeolidia* was described in the context of a molecular phylogeny, thus, no “taxonomic action” regarding to the unnamed species was taken, leaving the work incomplete, and the 50 % of the members of *Bulbaeolidia* undescribed. In this paper we describe the Western Atlantic member of the genus *Bulbaeolidia* and a Pacific species from Galapagos, both cryptic with *Bulbaeolidia alba* (Risbec, 1929).

Key words: Gastropoda, *Baeolidia*, *Baeolidia alba*, cryptic species, Western Atlantic, Caribbean, Eastern Pacific, Galapagos, taxonomic impediment.

RESUMEN

Recientemente se ha descubierto que el género de gasterópodo nudibranquio *Aeolidiella* Bergh, 1867 es polifilético y que contiene un clado no identificado; descrito como *Bulbaeolidia* Carmona, Pola, Gosliner y Cervera, 2013. Este género está compuesto por cuatro especies, dos de ellas sin nombre: *Bulbaeolidia alba*, de Japón, Malasia y Filipinas, *Bulbaeolidia japonica*, de Japón, *Bulbaeolidia* sp. B, de Hawai, y *Bulbaeolidia* sp. A, de

Brasil. *Bulbaeolidia* fue descrito en el contexto de una filogenia molecular, y no se realizó ninguna “acción taxonómica” con respecto a las especies sin nombre, dejando el trabajo incompleto y el 50% de los miembros de *Bulbaeolidia* por describir. En este trabajo se describe el miembro Atlántico del género *Bulbaeolidia* y una especie pacífica proveniente de las islas Galápagos, ambas crípticas con *Bulbaeolidia alba* (Risbec, 1929).

Key words: Gastropoda, *Baeolidia*, *Baeolidia alba*, especies crípticas, Atlántico Oeste, Caribe, Pacífico Este, Galapagos, impedimento taxonómico.

1. INTRODUCTION

The sea slug genus *Bulbaeolidia* Carmona, Pola, Gosliner & Cervera, 2013 is composed of small white aeolidacea, with rhinophores bearing two swellings, constricted oral tentacles and bilobed radular teeth. It was described by Carmona, Pola, Gosliner & Cervera (2013) in the context of a molecular phylogeny of the Family Aeolidiidae. These authors found that the traditional *Aeolidiella* Bergh, 1867 was a polyphyletic group, with an unnamed clade composed by four of the species they studied (*Aeolidiella alba*, from Japan, Malaysia and Philippines, *Aeolidiella japonica*, from Japan, *Aeolidiella* sp. B, from Hawaii, and *Aeolidiella* sp. A, determined as *A. alba*, from Brazil), which they determined as *Bulbaeolidia alba*, *Bulbaeolidia japonica*, *Bulbaeolidia* sp. B and *Bulbaeolidia* sp. A, respectively. CARMONA *et al.* (2013) justified undertaking no “taxonomic action” regarding to the species from Hawaii and especially Brazil, due to the need of more samples: “Concerning the cryptic species from Brazil previously attributed to *Aeolidiella alba*, more Atlantic specimens from Florida, as well as deep examination of their morphology, are needed in order to clarify its geographical distribution”, however they had enough data to describe a new genus and provide a diagnosis for it. After the great effort made by CARMONA *et al.* (2013), there are still two valid species known, *Bulbaeolidia alba* (Risbec, 1928) and *Bulbaeolidia japonica* (Eliot, 1913), and the 50 % of the members of *Bulbaeolidia* in the world remain to be described. Unfortunately, this happens often, because the “high impact” factor journals are not interested in taxonomy, so, after the phylogenetic hypothesis results, they tend to censor the parts of the papers related to the description of new taxa (new kind of Taxonomic impediment?), unless they are so important as the description of a new genus can be. But the work is still incomplete, and the authors have to choose between finishing it and publish in “low (or none) impact” factor journals, or start with a new phylogenetic hypothesis in other taxonomic group, to be published again in the journals that may grant them the access to a job.

In this paper we complete the effort of CARMONA *et al.* (2013), describing the Caribbean/Western Atlantic member of the genus *Bulbaeolidia* using samples from Cuba, Guadeloupe and Venezuela, and a Pacific species from Galapagos, which are cryptic with *Bulbaeolidia alba* (Risbec, 1929).

2. MATERIAL AND METHODS

Samples were obtained by direct search or by scraping, brushing, or examination of various substrates that were collected on the intertidal or by snorkelling or scuba diving.

The material collected in Guadeloupe was processed and examined onshore in a temporary laboratory installed by the MNHN in the Marine Biology facility of the Université des Antilles et de la Guyane. The external anatomy and coloration pattern of each specimen was studied using a stereoscopic microscope, photographed and preserved in ethanol 96%. The specimens from Galapagos were anesthetized with MgCl₂ and fixed in ethanol 70%. Jaws, radula and cnidosacs were extracted from the specimens, then, the radula was cleaned using NaOH to dissolve remaining tissues, rinsed with clean water and mounted in microscopy slides with glycerin. **Abbreviations:** IES-Instituto de Ecología y Sistemática, Havana, Cuba; IVIC- Marine Collections of the Instituto Venezolano de Investigaciones Científicas, Altos de Pipe, Ctra. Panamericana km 11, Venezuela; JOC-Jesus Ortea Collections, Noroña, Asturias, Spain. MCC-Manuel Caballer Collections, Boo de Pielagos, Cantabria, Spain. MNHN-Muséum national d'Histoire naturelle, 55 rue Buffon, 75005 Paris, France. TFMC-Museo de Ciencias Naturales de Tenerife, Organismo Autónomo de Museos, Santa Cruz de Tenerife, Canary Islands, Spain.

3. SYSTEMATICS

Family AEOLIDIIDAE Gray, 1827

Genus *Bulbaeolidia* Carmona, Pola, Gosliner & Cervera, 2013

CARMONA L., M. POLA, T.M. GOSLINER & J.L. CERVERA. 2013. A tale that morphology fails to tell: A molecular phylogeny of Aeolidiidae (Aeolidida, Nudibranchia, Gastropoda). *PLoS ONE*, 8(5): e63000. **Type species:** *Aeolidiella alba* Risbec, 1928 (by original designation).

Diagnosis: see Carmona, Pola, Gosliner & Cervera (2013).

Remarks: The designation of the type species appears in the caption of figure 2 and also through a link to Zoobank (<http://zoobank.org/NomenclaturalActs/EA7635CA-F380-4BED-9663-298641A2C1B8>).

Bulbaeolidia alba (Risbec, 1928) (Figure 1)

Aeolidiella alba Risbec, 1928: Contribution à l'étude des nudibranches Néo-Calédoniens. *Faune des Colonies Françaises*, 2: 1-328. **Type locality:** Pointe d'Artillerie, Noumea, New Caledonia.

Description: See Risbec (1928).

Remarks: *B. alba* is theoretically widespread all along the Indo-Pacific, that would mean that one small species of sea slug inhabiting the intertidal, has been able to colonize about 24 000 km of Ocean, more than half of the circumference of the Earth (if we don't consider the Atlantic records). The specimens from Japan, Malaysia and Philippines used by CARMONA *et al.* (2013) and determined as *B. alba*, were not compared with specimens cap-

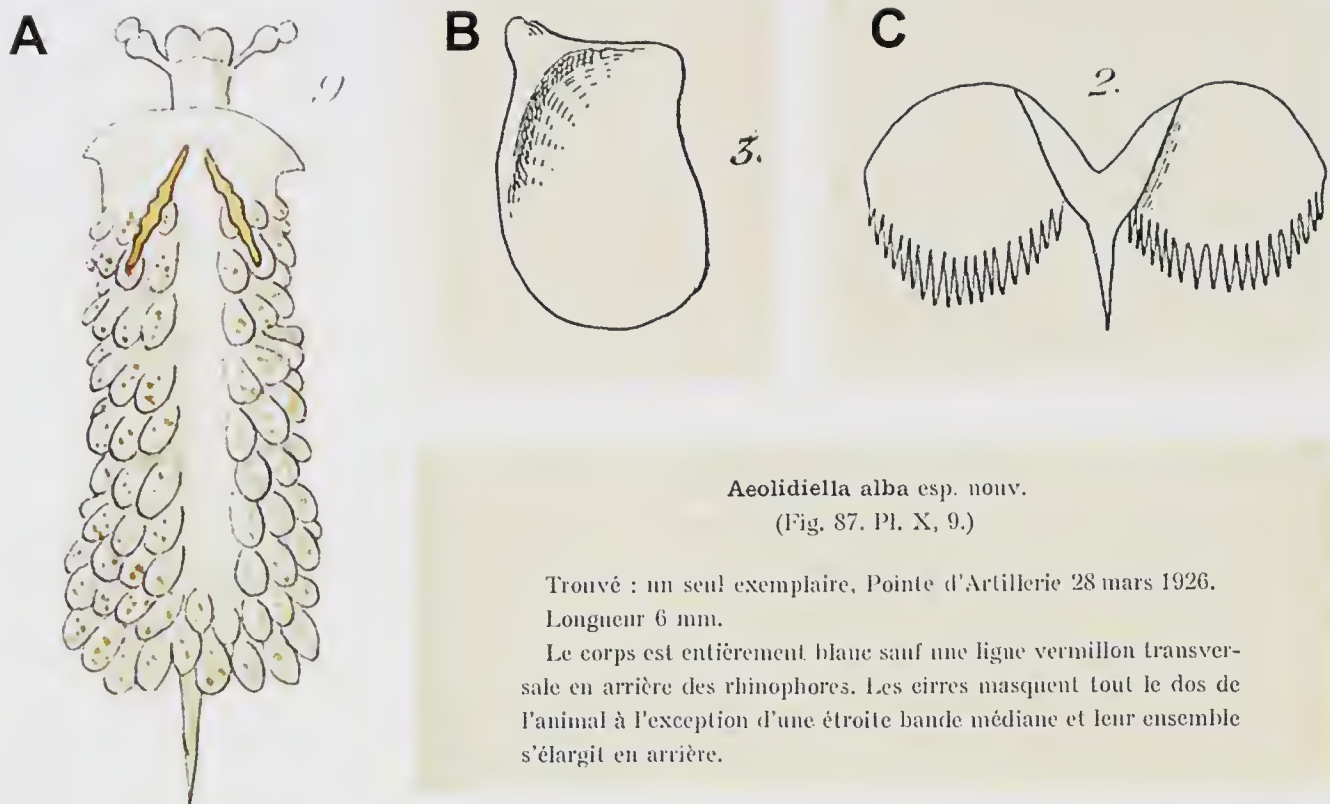


Figure 1.- *Bulbaeolidia alba* (Risbec, 1928): Iconotype, 6 mm long: **A**, Scheme of the animal in dorsal view; **B**, Jaw; **C**, Radular tooth.

tured in New Caledonia (the type locality), so, we cannot be sure of their real taxonomic identity, only that they all belong to the same species, thus, the distribution of *B. alba* is difficult to establish and have to be reviewed. On the other hand, these authors found a distinct member of the genus in Hawaii, initially named *Aeolidiella* sp. B. In the Indo-Pacific, *B. alba* has been recorded at least in (only first record is referred) New Caledonia (RISBEC, 1928), Australia (BURN, 1966), Tanzania (EDMUNDS, 1969), Pacific coast of Mexico (SPHON, 1971; 1978), South Africa (GOSLINER, 1985; 1987), Galapagos (GOSLINER, 1991), Seychelles, Papua New Guinea, Indonesia, Midway Atoll, Hawaii, Philippines (GOSLINER, BEHRENS & VALDES, 2008), Red Sea (YONOW, 2008), Japan and Malaysia (CARMONA *et al.* (2013).

Bulbaeolidia sulphurea
(Figure 2)

Holotype: 1 specimen 8 mm long, collected under rocks on the intertidal, March 18, 1991, deposited in TFM.

Type locality: Puerto Egas Santiago, Galápagos, Ecuador, 0°14'33.00"S, 90°51'25.64"W, J. Ortea.

Material examined: Corona del Diablo, Floreana, Galapagos, Ecuador, April 20, 1990, 1 specimen 10 mm long, collected on a rocky shelf at 10 m depth, deposited in JOC. Caleta James, Santiago,

Ecuador, March 12, 1991, 1 specimen 12 mm long, collected under rocks on the intertidal, deposited in JOC. Mosquera, Ecuador, March 3, 1991, 1 specimen 6 mm long (fixed), collected under rocks on the intertidal, deposited in MCC.

Etimology: *Bulbaeolidia sulphurea*, because of the yellow-sulfur color of the rhinophores and oral appendages.

Diagnosis: Body pinkish-white, wide and short. Rhinophores yellow-sulfur. Oral appendages yellow-sulfur, cylindrical, slightly constricted. Base of rhinophores surrounded by a red square band. Cerata flattened, pinkish, with opaque white dots and yellow-sulfur tips. Jaws with an apical conical “crest”. Radular formula: $16 \times 0.1.0$. Radular teeth with the central cusp lower than the lateral denticles. Tail very short, never surpassing the last cerata. Moves forward with discontinuous rhythmic movements (like jumps), occasionally, scrolls crawling for a little while.

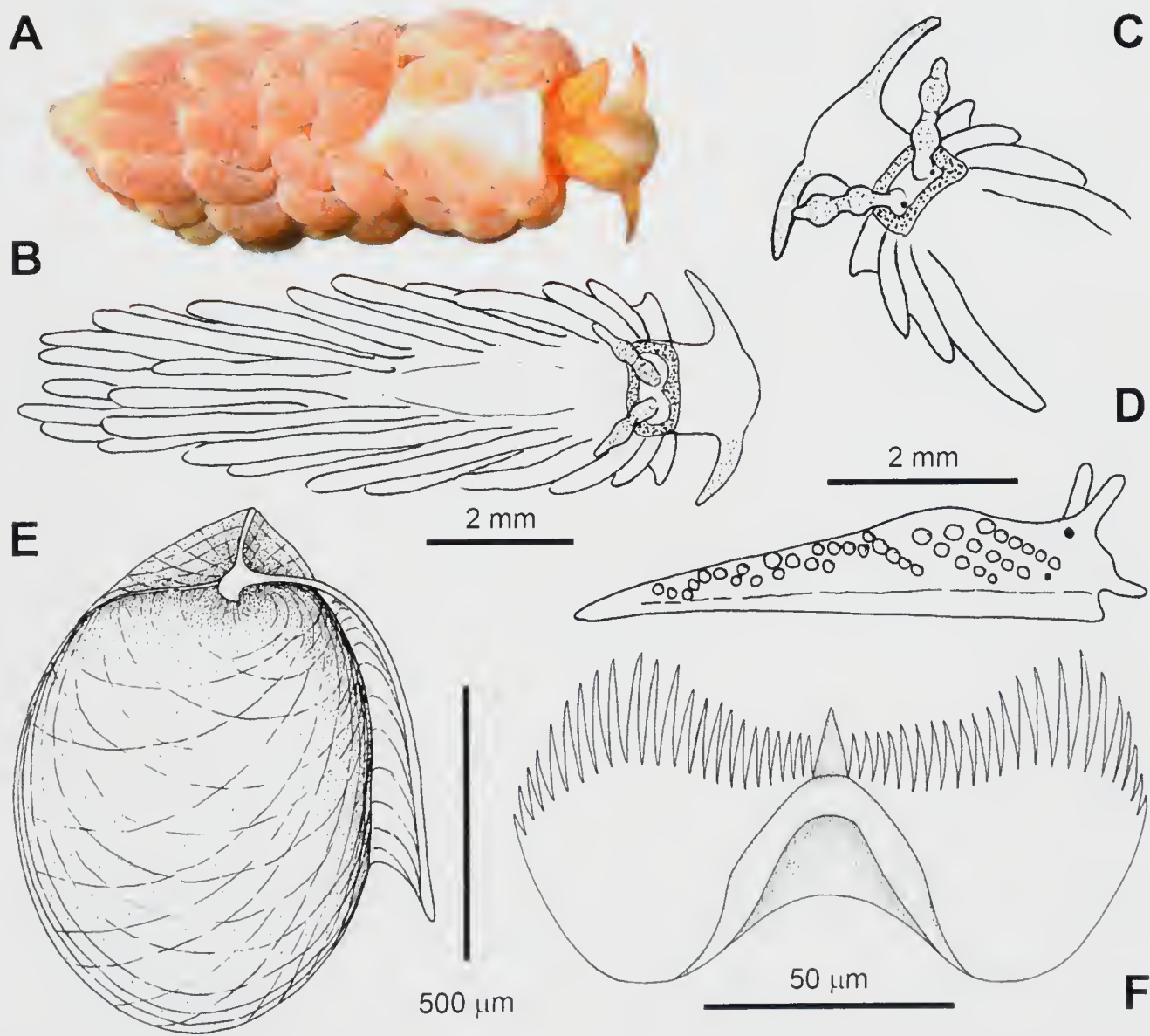


Figure 2.- *Bulbaeolidia sulphurea* n. sp.: **A**, Living animal; **B**, Field drawing of the living animal moving forward; **C**, Detail of the head of the animal stopping; **D**, Scheme of the animal in lateral view (fixed), arrangement of cerata; **E**, Jaw; **J**, Radular tooth.

Description: Up to 12 mm. Body pinkish-white, proportionally wide and short. Rhinophores yellow-sulfur, with two swellings and a widened apex. Lower swelling whitish sometimes. Base of rhinophores surrounded by a red square band, which can also tinge the first cerata. Eyes at the base of rhinophores. Foot corners rounded and short. Foot sole whitish to creamish-pink. Oral appendages yellow-sulfur, cylindrical and thick, with a slight constriction and a sharpened tip. Digestive gland inside cerata blackish. Cerata flattened, pinkish, with opaque white dots that can cover their whole surface and yellow-sulfur tips. Shorter, more robust and arranged in a more compact manner in the specimens from the intertidal, which uses them for defence when disturbed. First row of cerata arched forward. Posterior 5-7 rows composed by 5 cerata. Last rows disordered. Tail very short, nor surpassing the latest cerata. Anus posterior to the outermost cerata of the fifth row. Gonopore posterior to outermost cerata on second row.

Jaws oval and strong, 700 μ m wide and 950 μ m high, with with an apical conical “crest” and a smooth and very long and smooth cutting edge. Radular formula $16 \times 0.R.0.$ in 1 specimen 6 mm long (fixed) from Mosquera (Galapagos). Radular teeth 125 μ m wide and 65 μ m high, homogeneous in size, with 20-23 denticles on each side of the central cusp, which is shorter than the denticles.

Biology and behavior: Feed on anemones. Moves forward with discontinuous rhythmic movements (like jumps), occasionally, moves crawling for a little while.

Distribution: Galapagos Islands (Ecuador).

Remarks: *B. alba* is distinguished from *B. sulphurea* n. sp. by the color of the body, opaque white; the oral appendages, thicker, with a blunt tip; the brown rhinophores, with more prominent swellings; the jaws which are not oval and have a distinct shape and crest; and by the radular teeth with the central cusp longer than the lateral denticles, which are only 19 (Risbec, 1928).

B. japonica is distinguished from *B. sulphurea* n. sp. by its body, up to 50 mm, slender, brownish white, scattered by numerous white to yellowish white patches, with brown head; the cerata, dark brown, slender, thin and more abundant; the rhinophores, with 3-4 rings; the radular formula $18 \times 0.R.0.$ in specimens 5 times bigger; and by the radular teeth with the central cusp longer than the lateral denticles, which are 65 and small (Eliot, 1913; Okutani, 2000).

B. sulphurea n. sp. has been recorded in Galapagos as *Aeolidiella alba* by Gosliner (1991). The species identified by CARMONA *et al.* (2013) as *Bulbaeolidia* sp. B from Hawaii could be related to *B. sulphurea* n. sp.

With *B. sulphurea* n. sp., the number of species described in Galapagos as a result of the TFMC campaigns has raised to 10. The previous ones are: *Berlanguella scopae* Ortea, Bacallado & Valdés, 1992, *Felimida ruzafai* (Ortea, Bacallado & Valdés, 1992), *Thorunna talaverai* Ortea, Bacallado & Valdés, 1992, *Eubbranchus eibesfeldti* Ortea, Caballer & Bacallado, 2003, *Mexichromis tica* Gosliner, Ortea & Valdés, 2004, *Doto xangada* Ortea, 2010, *Doto xangada* Ortea, 2010, *Berthellina barquini* Ortea, 2014 and *Berthellina magma* Ortea, 2014 (ORTEA, BACALLADO & VALDÉS, 1992; ORTEA, CABALLER & BACALLADO, 2003; GOSLINER; BACALLADO & VALDÉS, 2004; ORTEA, 2010; ORTEA, MORO & CABALLER, 2014).

***Bulbaeolidia oasis* n. sp.**

(Figure 3)

Holotype: 1 specimen 8 mm long, February 17, 2005, deposited in IES, Cuba.

Type locality: Dock of Oasis Hotel, Varadero, Cuba, 23° 7'57.90"N, 81°19'3.78"W, M. Caballer, J. Ortea.

Material examined: stn GD57, Derriere Ilet Fajou, Guadeloupe, France, 16°19,21'N, 61°35,32'W, May, 2012 collected at 6 m depth, deposited in MNHN. Isla de Aves, Venezuela, 15°39'24.77"N, 63°36'57.68"W, June 2, 2009, 1 specimen 1.9 mm long (fixed), collected at 9 m depth on *Dictyota* spp., deposited in IVIC (IVICCM000158).

Etimology: *Bulbaeolidia oasis*, named for the locality in the Caribbean in which we saw this species for the first time, the Hotel Oasis, in Varadero, Cuba, and for the friends we met there, who helped us with the logistics.

Diagnosis: Body markedly flattened and cream-whitish. Oral appendages opaque white, short, constricted at the midpoint. Lacking a red square band surrounding the base of rhinophores. Cerata cream-whitish, with reddish spot on the tip, compacted over the dorsum. Jaws with an apical "crest". Radular formula: 12 × 0.1.0. Tail very long and thin. Rhinophores rock rhythmically backwards and forwards, but not the rest of the body.

Description: Up to 8 mm. Body markedly flattened, cream-whitish, proportionally wide. Head opaque white and wide. Rhinophores with two swellings, white, with reddish transverse striations, simulating rhinophoral sheaths or wrinkles in the animal Cuba, this character missing in the specimen from Guadeloupe, which was white. Lower swelling thicker, with variable shape, sometimes discoidal. Apex of rhinophores thick and white. Red square band surrounding the base of rhinophores absent. Eyes visible at the laterals of the base of rhinophores, within a cream-colored area outlined by a reddish-brown line. Foot translucent, with rounded foot corners. Oral appendages opaque white, short, constricted at the midpoint. Cerata cream-whitish, with reddish spot on the tip, short, curved inwards, arranged in a compact manner over the dorsum, lacking shaking or stretching movements. Cnidosac 250 µm long (fixed), full of simple rods 60-70 µm long. There are 14 rows on each side, with 4-5 cerata. Digestive gland inside cerata not branched. Tail very long (one third of the total length) and thin, translucent, widely surpassing the lattest cerata. Gonopore posterior to outermost cerata on second row.

Jaws oval and strong, 530 µm wide and 730 µm high, with an apical "crest" and a smooth and very long and smooth cutting edge. Radular formula 12 × 0.R.0. in 1 specimen 8 mm long from Cuba. Radular teeth 100-120 µm wide and 50-55 µm high, homogeneous in size, with 23-25 denticles on each side of the central cusp, which is shorter than the denticles.

Biology and behavior: Feed on anemones. When the animal crawls, its rhinophores are rocked rhythmically backwards and forwards (like jumps), but not the rest of the body or the cerata. The spawn is a transparent wavy and open ribbon, with opaque white eggs arranged in 2 rows (in dorsal view). The height of the ribbon is 1 mm, and there are 8 eggs on each of the 2 rows.

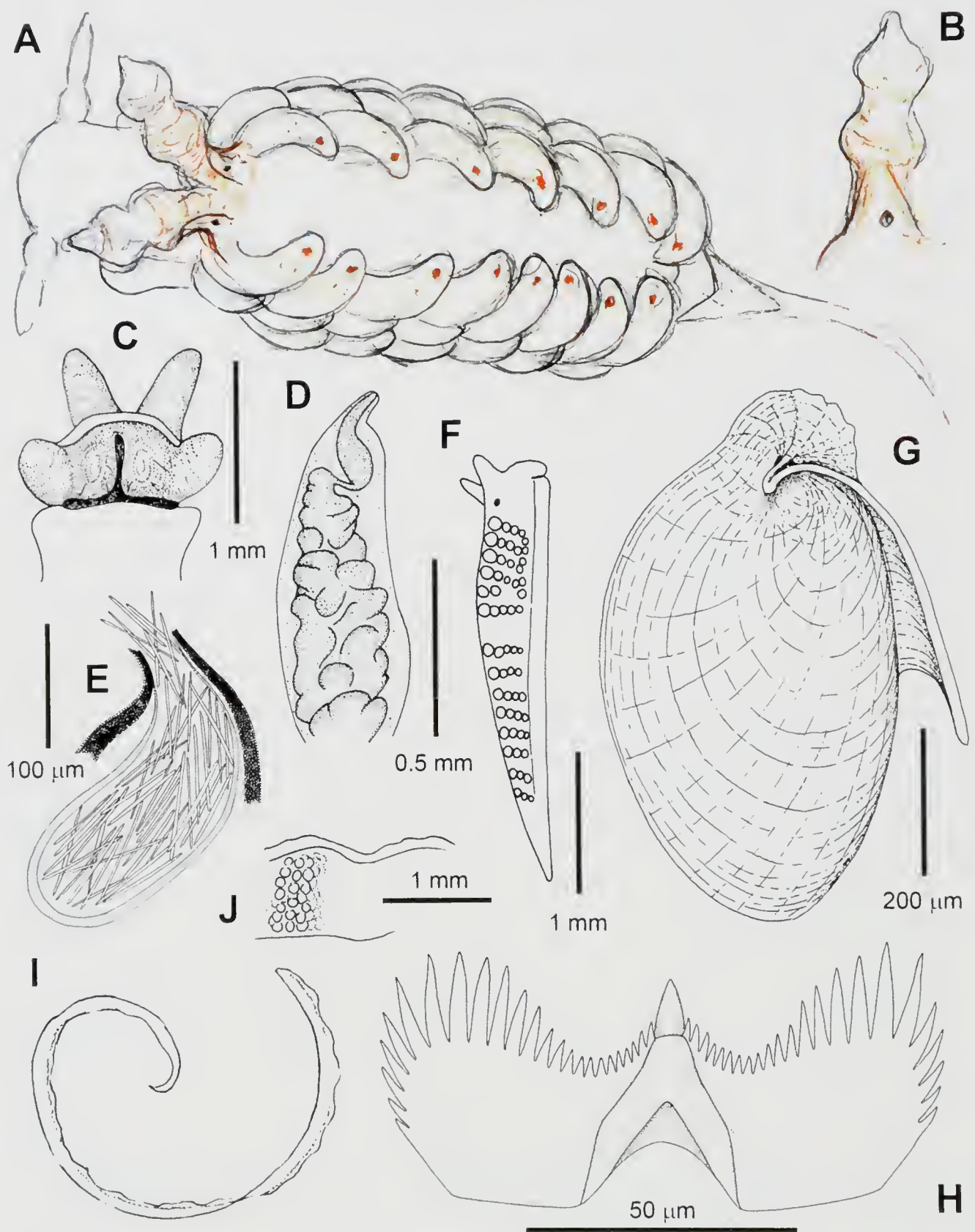


Figure 3.- *Bulbaeolidia oasis* n. sp. from Cuba: **A**, Scheme of the animal in dorsal view; **B**, Lateral view of the rhinophore; **C**, Ventral view of the head (fixed); **D**, Scheme of the cerata (fixed); **E**, Scheme of the cnidosac and its content (fixed); **F**, Scheme of the animal in lateral view (fixed), arrangement of cerata; **G**, Jaw; **H**, Radular tooth. **I**, Spaw.

Distribution: Barbados (EDMUNDS & JUST. 1983: as *Spurilla alba*), Brazil (PADULA & SANTOS, 2006; CARMONA *et al.*, 2013), Cuba, Guadeloupe (ORTEA, ESPINOSA, CABALLER & BUSKE, 2012: as *Aeolidiella alba*), Venezuela.

Remarks: *B. alba* is distinguished from *B. oasis* n. sp. by the thicker oral appendages; the rhinophores, lacking the pattern of reddish transverse striations in of the holotype of *B. oasis* n. sp.; the red square band surrounding the base of the rhinophores; the cerata lacking a reddish spot on the tip; the shorter tail; the jaws which are not oval and have a distinct shape and crest; and by the radular teeth with the central cusp longer than the lateral denticles, which are only 19 (Risbec, 1928).

Unlike *B. oasis* n. sp., *B. japonica* has a body up to 50 mm, slender, brownish white, scattered by numerous white to yellowish white patches, with brown head; dark brown cerata, slender, thin and abundant; rhinophores with 3-4 rings; a radular formula $18 \times 0.R.0.$ in specimens 5 times bigger; and radular teeth with the central cusp longer than the lateral denticles, which are 65 and small (Eliot, 1913; Okutani, 2000).

B. sulphurea n. sp. has pinkish-white body, yellow-sulfur rhinophores, a red square band surrounding the base of the rhinophores, cylindrical, thick and yellow-sulfur oral appendages, cerata pinkish with yellow-sulfur tips and a very short tail, distinct from *B. oasis* n. sp. In addition, *B. sulphurea* n. sp. has bigger jaws with and arrow-shaped crest, and higher radular teeth with less lateral denticles in a bigger specimen.

With *B. oasis* n. sp. the number of sea slug species in Venezuela (CABALLER, ORTEA, RIVERO, CARIAS, MALAQUIAS & NARCISO, 2015) has risen to 135. The number of species in Guadeloupe remains 151 (ORTEA *et al.*, 2012; ORTEA, ESPINOSA, BUSKE & CABALLER, 2013; CABALLER & ORTEA, 2014; 2015), but the record of *Aeolidiella alba* has to be replaced by *B. oasis* n. sp. The number of species in Cuba is very difficult to be established, but briefly, at least 97 species have been cited in the country (ESPINOSA, ORTEA, CABALLER & MORO, 2005; ESPINOSA, ORTEA, FERNÁNDEZ-GARCÉS & MORO, 2007; ORTEA & CABALLER, 2006; CABALLER & ORTEA, 2007), so, with *B. oasis* n. sp. this number would be raised to 98, but a revision is needed due to the high number of scientific papers published in this matter.

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